

**ARRANGEMENT FOR ELECTRICAL CONNECTION**

The invention relates to an arrangement for electrically connecting an electrical unit to at least one electrical component by means of a flexible foil conductor, wherein said electrical unit comprises at least one electrical assembly and is arranged inside a case and wherein said at least one electrical component is provided outside the case.

Patent document DE 197 51 095 C1 describes the arrangement of a control unit inside a gearbox case of a motor vehicle, in which the electrical connection member that connects the control unit to the electrical components that are arranged outside the case consists of a single flexible foil conductor and has a double function, which means that the electrical connection member connects the control unit to the electrical components that are arranged outside the case on the one hand and jointly contacts several components that are arranged inside the case on the other hand. The control unit comprises at least two case parts that are interconnected in an airtight manner and through which the electrical connection member is led.

The flexible foil conductor consists of a single piece. In complex arrangements, this design results in a lot of scrap, if one only takes into consideration the recess for the control unit in the middle of the foil conductor, and is therefore uneconomical. Moreover, the positions of the electrical components arranged inside and outside the case are fixed on account of the shape of the foil conductor, which means that the change of the position of just one component requires the change of the shape of the whole foil conductor. This requirement seriously restricts the designing options in the manufacturing process.

A further disadvantage of this arrangement consists in the fact that performance and quality, for example regarding the tightness of the arrangement or the quality of the electrical contacts, cannot be checked until a very late stage of the manufacturing process which may result in very expensive rework or even high reject costs.

The object of the present invention is to provide a simple, flexibly usable, economical and process-safe arrangement for electrically connecting an electrical unit to

electrical components, wherein said electrical unit comprises at least one electrical assembly and is arranged inside a sealed case and wherein said electrical components are provided outside the case.

This object is achieved by an arrangement having the features of claim 1, that is to say by additionally providing several assemblies inside the case of a known arrangement, wherein each assembly is connected to its associated component/s provided outside the case via a separate foil conductor.

There is almost no foil scrap on account of the fact that the electrical connection of the electrical assemblies inside the case to their associated electrical components outside the case is not established by a single big foil conductor but by one separate foil conductor of precisely adapted size and shape per assembly. The arrangement is thus cost-optimized regarding the very expensive foil conductor. In comparison with the single-foil solution, it is a further advantage of the arrangement that the conductor tracks of the foil conductor only consist of parallel straight lines which simplifies the foil layout and thus makes it more cost-effective.

According to a preferred exemplary embodiment of the present invention, the case preferably comprises a top cover, a circumferential wall, a base plate that preferably forms a single piece with the wall, and at least one bearing plate, thereby providing a compact case.

In particular, the electrical unit arranged inside the case is mounted to the base plate in such a manner that a space is formed between the electrical unit and the circumferential wall, wherein the bearing plate is arranged between the wall and the electrical unit. The base plate preferably comprises a recess adjacent to an assembly, between the wall and the electrical unit. In particular, the bearing plate is arranged in the recess of the base plate in such a manner that the intermediate separate foil conductor is connected to the case in a sealing-tight, in particular, in an airtight fashion. The contacts establishing the electrical connection of the assembly to the foil conductor extend into the recess, thereby advantageously improving process safety. If the electrical connection of the electrical components arranged outside the case to the foil conductor is already established and checked prior to establishing the

contact between the foil conductor and the assembly arranged inside the case, there will be no need for rework. Such rework would be necessary in case of any defects only detected after final assembly. It is a further advantage of this arrangement that the tightness of the joint between the bearing plate and the base plate can be checked immediately after joining the two plates, thereby eliminating the need for any rework which rework would be necessary in case of any defects only detected after final assembly.

It is a further advantage of this arrangement that the overall layout can be changed quickly and without any major material or financial requirements, which is particularly important in the development stage of a product. It is possible to react very flexibly to any change in the arrangement of the electrical assemblies inside the case by shifting a recess in the base plate or adding a new recess to the base plate without having to change the rest of the overall arrangement. If the positions of any electrical components outside the case have to be changed subsequently, whether in the x-direction or in the y-direction or in the z-direction, it is only necessary to change the shape of the positioning device of the electrical components outside the case. The electrical connection continues to be guaranteed by the flexibility of the foil conductor, and the rest of the overall arrangement remains unaffected.

Preferably, the flexible foil conductor is integrally joined to the base plate or bearing plate in the portion of the leadthrough by, for example, adhesive bonding or laminating. This increases the degree of tightness of the arrangement and improves the positionability of the flexible foil conductor during mounting. A tape that is adhesive on both sides can also be used for adhesive bonding.

Advantageously, placing a seal between the flexible foil conductor and the base plate or bearing plate can improve the tightness of the arrangement. This seal can be an O-ring, a compression seal, an elastic adhesive, or a collar joint.

Preferably, the plate that does not contact the foil conductor directly is provided with a groove for receiving the seal, thereby fixing the seal and facilitating the assemblage of the arrangement.

According to a particularly preferred exemplary embodiment of the present invention, the electrical unit arranged inside the case is a control device that receives signals from electrical components arranged outside the case and/or controls electrical components arranged outside the case. Such signals can be transmitted by a temperature sensor, for example. This information can be used for controlling a solenoid valve, for example. This arrangement is very compact and provides a very large number of different application options.

The present invention will now be described in greater detail on the basis of the attached drawings.

Fig. 1 is a part of a diagrammatic section of a case that includes a control device.

Fig. 2 is a schematic representation of a section through Fig. 3 in the plane A-A.

Fig. 3 is a schematic representation like Fig. 1, wherein a seal is arranged in a groove in the front of the recess in the base plate.

Fig. 4 is a schematic representation like Fig. 3, wherein a seal is arranged in a groove in the bearing plate.

According to Fig. 1 and Fig. 2, the arrangement comprises a control device 9 inside a case 10, wherein the case 10 comprises a top cover 4, a circumferential wall 2, a base plate 3 that preferably forms a single piece with the wall 2, and at least one bearing plate 5. The case 10 is arranged (in a manner not shown here) under the gearbox bell between the gearbox and the hydraulic block and is thus surrounded by gear lubricant oil on one side and hydraulic oil on the other side. The top cover 4 seals the case 10 against the gear lubricant oil by means of the seal 8 that is placed in a circumferential groove 15 in the front face of the wall 2. The top cover 4 can be fastened by screwing or caulking. However, the arrangement can also be sealed without using a seal. For this purpose, the front of the circumferential wall 2 forms a plane sealing face, and the top cover 4 is fastened by screwing or caulking in the presence of sufficient contact pressure. If metallic materials are used, the joining can also be carried out by welding.

The control device 9 is fixedly attached to the base plate 3. In particular, a space is left between the control device 9 and the circumferential wall 2 in such a manner that the bearing plate 5 can be placed there.

Electrical assemblies 17 are arranged on the control device 9. In the portion of an assembly 17, between the control device 9 and the circumferential wall 2, there is a recess 11 in the base plate 3. Through this recess 11, each electrical assembly 17 is connected to the electrical components 18 provided outside the case 10 via a separate flexible foil conductor 6, wherein the components 18 can be, for example, a sensor (such as a temperature sensor), or an actuator (such as a solenoid valve), or several (even different) components. The components 18 can extend into both the gearbox part and the hydraulic part. It is an advantage of this arrangement that the conductor tracks of each separate foil conductor 6 consist of parallel straight lines which simplifies the overall foil layout.

The connection of the electrical assembly 17 to the respective flexible foil conductor 6 is established by the contacts 12 that are bonding wires in this case. The flexible foil conductor 6 is connected to the base plate 3 in a sealing-tight, in particular, in an oiltight fashion by means of the bearing plate 5 that presses the flexible foil conductor 6 against the front 13 of the recess 11 and is fixedly attached to the base plate 3 by screwing or caulking. The tightness of the arrangement can be improved (in a manner not shown here) by fitting an additional seal between the foil conductor 6 and the bearing plate 5 or base plate 3.

Advantageously, the respective electrical components 18 are electrically contacted at one end of the individual foil conductor 6 and inserted into a positioning device (that is not shown here) prior to establishing the electrical contact 12 to the associated assembly 17 inside the case 10 at the other end of the foil conductor 6. By simultaneously fitting the bearing plate 5, the associated foil conductor 6 and the associated positioning device, the electrical components 18 are already fixed in their final positions.

The contact 12 between the electrical assembly 17 arranged inside the case 10 and the separate foil conductor 6 is now established. In this manner, the modules that consist of the components 18 outside the case, the foil conductor 6, the positioning

device and the bearing plate 5 can be connected one by one to the base plate 3 through the respective recess 11 in the portion of the respective assembly 17 in an airtight manner.

This type of arrangement enables both the case 10 and the module to be standardized for similar applications as far as possible. Moreover, if there is a defective contact 12 between an electrical assembly 17 and a foil conductor 6 and later contacting is not possible, it is only necessary to replace the respective module.

The flexible foil conductor 6 can be integrally joined to the base plate 3 or bearing plate 5 in the portion of the recess 11 by, for example, adhesive bonding or laminating. This increases the tightness of the arrangement and improves the positionability of the flexible foil conductor 6 during mounting. In particular, a tape that is adhesive on both sides can be used for adhesive bonding. The whole arrangement will assume a modular character if the foil conductor 6 is already connected to the bearing plate 5 and the contact to the electrical component/s 18 arranged outside the case 10 is established prior to connecting the bearing plate 5 to the base plate 3.

Fig. 3 shows the arrangement of a seal 7 in a circumferential groove 14 in the front 13 of the recess 11. This facilitates the assemblage of the arrangement by fixing the position of the seal 7 in the groove 14.

Fig. 4 shows the arrangement of a seal 7 in a groove 16 in the bearing plate 5, wherein the shape of the groove 16 follows the shape of the front 13 of the recess 11. The seals 7 and/or 8 can be O-rings, compression seals, elastic adhesives, or collar joints.

**LIST OF REFERENCE NUMERALS**

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|----|--|
| 2  | wall                                   |
| 3  | base plate                             |
| 4  | top cover                              |
| 5  | bearing plate                          |
| 6  | flexible foil conductor                |
| 7  | case seal, bearing plate               |
| 8  | case seal, wall                        |
| 9  | electrical unit                        |
| 10 | case                                   |
| 11 | recess                                 |
| 12 | contact                                |
| 13 | front of the recess                    |
| 14 | groove in the front of the recess      |
| 15 | groove in the wall                     |
| 16 | groove in the bearing plate            |
| 17 | electrical assembly                    |
| 18 | electrical components outside the case |